2 endcaps, 2 compensation electrodes, and the central ring) with lengths and diameters carefully chosen to produce a harmonic, orthogonalized, quadrupole potential in the central region [37], and a cylindrical high voltage exit electrode. For the purpose of the initial antiproton capture the trapping region is defined by the entrance foil and the high voltage exit electrode. This region of the trap has no harmonic properties and will be referred to as the "catching trap" throughout this paper. The central, harmonic region serves a dual purpose: to initially hold cold electrons in preparation for the electron cooling, and then to collect the cooled antiprotons after the electron cooling has taken place. This trap is instrumented with two independent tuned circuits for the detection of electrons and antiprotons via the signals induced in the compensation rings and for resistively cooling the antiprotons after the electrons have been ejected. An incoming beam pulse from LEAR will loose energy in the entrance electrode, which acts as a degrading foil, and if the energy of the beam is carefully tuned by changing the upstream density of material to be traversed, a maximum number of antiprotons below 30 keV will emerge from the down stream side - theoretical predictions are calling for 2.8 % [41] - and travel towards the exit electrode. Here they are reflected by the applied potential, but before they can reach the degrading foil again, the potential on this entrance electrode is quickly ramped up and the particles are confined. In recent test experiments up to approximately 1 million antiprotons have been captured in this way and have been electron cooled to low energies within a few minutes. Figure 4 shows a schematic of the trap and a sample of an energy spectrum of captured antiprotons before electron cooling. More details on this experiment are given elsewhere in these proceedings [42].

5.2. Plasma Studies in Ion Traps

Another area in which traps have entered an area of physics where they were not expected to play an important role at first sight is the field of plasma physics. Leaving the idea of a single particle freely floating in space behind and pushing for the maximum number of particles which possibly can be put in a trap collective behaviour starts to play a more and more important role. One can ask the question on how many particles one can pack into the trap volume and by the simple consideration that the radially confining magnetic force must overcome the repulsive electrical force due to both the applied external potential and the internal space charge potential one arrives at a maximum density (the Brillouin density) of approximately $2.7 \times 10^9 B^2$ 1/cm^3, where B is the magnetic field in Tesla. Densities at this limit have been achieved, mostly by loading a cloud and then spinning up its rotation with an external torque. Conservation